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The Telescope Array's Middle Drum Observatory

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Abstract: The Telescope Array Project (TA) is an Ultra High Energy Cosmic Ray Observatory in central Utah, USA. It performs hybrid measurements of the extensive air showers induced by cosmic rays. The two main detector systems are 1) an array of 576 scintillation detectors and 2) three fluorescence telescope observatories which overlook the ground array. The Telescope Array will measure the spectral shape and chemical composition of primary cosmic rays in addition to searching for sources or other anisotropy. The Telescope Array also seeks to understand the difference between the HiRes (High Resolution Fly's Eye) and AGASA (Akeno Giant Air Shower Array) spectra. The Middle Drum Observatory has been instrumented using refurbished telescopes from the HiRes-I Observatory at Dugway. We will discuss the detectors, modifications to aid calibration and analysis from this observatory.

Overview

The Telescope Array Project is presently planned in two stages. The first stage or standard TA experiment is designed to observe ultra high energy cosmic rays with energies greater than about 10^{19} eV. The second stage of the experiment is known as the Telescope Array Low-energy Extension (TALE) and will extend the reach of the experiment to near 10^{16} eV. When complete, the project will consist of a variety of detector elements and make hybrid observations over the full range of energies. It will measure the study spectral shape and chemical composition of primary cosmic rays as well as search for sources and anisotropy. Especially in the first stage, TA seeks to understand the difference between the HiRes (High Resolution Fly's Eye) and AGASA (Akeno Giant Air Shower Array) spectra.

The first stage of the Telescope Array Project consists of two main detector systems: 1) an array of 576 scintillation detectors on a 1.2 km grid and 2) three fluorescence telescope observatories which overlook the ground array. The three fluorescence observatories sit (approximately) at the corners of a 30km equilateral triangle and overlook the array of scintillation detectors within. Figure 1 shows a map of the project as well as the relative location to the High Resolution Fly's Eye experiment and to Salt Lake City.

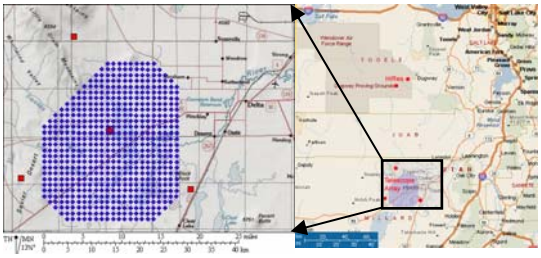

Figure 1: Map of the Telescope Array site showing the locations of the three exterior fluorescence stations (squares), the central laser facility (cross), and the positions of the scintillation counter (diamonds). The panel on the right shows the scale of the site in the context of a roadmap of north-central Utah, in which the two HiRes sites are indicated as circles. The fluorescence station in the south-east is the Black Rock Mesa (BRM) site. The south-western station is known as Long Ridge (LR) and the station in the north is known as Middle Drum (MD).

The scintillation detectors, the southern two fluorescence detectors, and the central laser facility are the subjects of other papers submitted to this conference.

The Middle Drum Observatory

The northern-most fluorescence observatory has been constructed using refurbished equipment from the old HiRes-I observatory at Little Granite Mountain (aka Five Mile Hill). The equipment has been modified somewhat and has been relocated to a new building which itself provides some interesting new capabilities and possibilities.

Figure 2: The Telescope Array Project: Middle Drum Observatory Building.

Figure 3: One of the PI's in front of a bay door to show scale

A picture of the Middle Drum Observatory is shown in Figure 2. The building, which houses 14 telescopes, consists of seven bays each about the size of a two car garage. As is readily apparent from the photo, this building is very different from either our Dugway/HiRes buildings, our original thoughts for the site (potentially putting each telescope in its own inclined conex box) or from the University of Tokyo designed buildings at Black Rock Mesa and Long Ridge. Several considerations were part of this decision. Among these were 1) putting everything in one building where the floor was flat made it much easier to work on the detectors (installation, servicing, calibration, etc). 2) the "inward looking" building has a point in front of the building which all of the telescopes can observe (we will locate a vertical xenon flasher or some other calibration light source at that location) 3) in HiRes we used a Roving Xenon Flasher (RXF) as our "standard candle" to calibrate the detectors – with the present building we have plans for installing an RXF on a track allowing it to calibrate in an automated manner 4) it will be easier to install cable trays, cables, etc… 5) putting all telescopes in one building without walls between saved overall cost 6) this building has reduced garage door size (especially with respect to the Black Rock and Long Ridge sites) which should result in fewer wind locking problems 7) the pointing directions of the mirrors have very different centers which will decrease parallax uncertainty in reconstruction.

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